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(19)(CA) **APPLICATION FOR CANADIAN PATENT** (12)

(54) Pigmented and Fluorescing Interiorly Illuminated Bodies

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(57) 4 Claims

Notice: This application is as filed and may therefore contain an incomplete specification.

Canada

ABSTRACT OF THE DISCLOSURE

The invention relates to internally illuminated bodies made of sheets of transparent, weather-resistant synthetic resin such as polymethyl methacrylate containing a white pigment and a fluorescent dye, the surface to volume ratio A : V of the bodies being less than 6 : X, where X is the minimum cross section in the plane in which the light source is located.

The present invention relates to interiorly illuminated bodies comprising sheets of synthetic resin containing a white pigment and a fluorescent dyestuff, which bodies can be uniformly illuminated even when constructed to be of small depth. More in particular, the synthetic resin may be polymethyl methacrylate and further dye may be present in the resin. These illuminated bodies can be used, for example, for illuminated advertising, for traffic signals, or for signs.

The use of fluorescent dyes in combination with white pigments for the optical brightening of synthetic resins has been known for a long time (e.g. K. Eschle, Plastverarbeiter 21 (7), pages 629 to 632, 1970). DE-OS 27 10 379 describes polyester fibers having a brilliant white tone which are prepared by polycondensation of a mixtures of polyester components with titanium dioxide and a fluorescent dye followed by spinning from a melt.

The preparation of substitute materials for white translucent paper ("Japan-Papier") is described in JP-A 74-052-868 by the mixing, in a melt, of polyethylene, polypropylene, glass fibers, calcium carbonate, titanium dioxide, and fluorescent dyes with subsequent extrusion of thin films.

EP 171 776 describes colored round rods of a transparent synthetic resin material, particularly acrylic glass, containing fluorescent dye with the feature that the round rod has a longitudinal zone of covered material, which can also be colored.

Fluorescing coating materials consisting of fluorescent dye,

calcium sulfite, acrylate polymers, and solvents in dispersions which have a superior fluorescence and light stability are claimed in Japanese Kokai 78 133 240.

EP-PS 72 949 describes traffic and directional signs which have a small light source within an illuminated body of synthetic resin which contains a fluorescent dye or is completely transparent. The outward-facing surfaces of these signs, excepting the front side, can be coated with a reflecting material, for example with a layer containing a white pigment.

JP-PS 88 00 4583 claims shaped bodies, such as sheets, films, rod, tubes, or fibers of a polymethyl methacrylate molding compound which contains an organic fluorescent dyestuff. Light having a broad spectrum of wavelengths which is absorbed by the shaped bodies is transformed to light of higher wavelengths having a narrow wavelength spectrum.

German utility model G 91 03 495.7 describes a lighting arrangement containing a principal surface, illuminated from the rear side, made of light-transparent synthetic resin and having at least one of the light sources illuminating the principal surface arranged such that the light directly leaving the source is non-uniformly distributed on the rear side of the principal surface, with the proviso that the principal surface is made of a material having a reflection greater than 80%, an absorption below 10%, and a transmission below 10% and that there is a white surface having a reflection greater than 80% behind the principal surface and parallel to it.

In illuminated bodies such as are used for advertising or as signs, the lowest possible expenditure of energy is sought for the light source, such as filament or fluorescent bulbs. For this reason, the smallest possible distance between the light

rce and the wall of the illuminated body (= surface of the illuminated body) is sought for. For this, walls of the illuminated body which cast a diffuse light and in this way hinder a punctiform transmission of the light source or sources are necessary. This is usually solved by providing a large distance between the lights source(s) and the wall of the illuminated body, the so-called "depth" of construction. Because of this, the light sources must provide a light emission of high energy (the intensity of light from a point source decreases with the inverse square of the distance) in order to assure a uniform illumination of all walls of the illuminated body.

The polyester synthetic resins containing titanium dioxide as a white pigment and a fluorescent dye described in DE-OS 27 10 379 are poorly suited for illuminated bodies because of their insufficient transparency and, therewith, decreased light transmission.

Also, the substitutes claimed in JP-A 74 052-868 for white translucent paper show insufficient transparency and stability of shape for use as illuminated bodies.

EP 171 776 describes massive round rods of transparent synthetic resin containing fluorescent dye and having a zone of covered material. Use as illuminated bodies having an interiorly located light source is excluded by the massive construction of the round rods.

Fluorescing coating materials such as are claimed in Japanese Kokai 78 133 240, which are applied as dispersions, have too small a layer thickness to assure an efficient diffuse scattering of light.

The synthetic resin illuminated bodies described in EP-PS 72 949 are made of synthetic resins which can contain

fluorescent dyes and which can have layers containing white pigment on those surfaces directed outwardly. These white pigment layers serve to reflect light and, correspondingly, show no or only very limited transparent character.

Shaped bodies according to JP-PS 88 00 4583 consist of polymethacrylate molding compound containing an organic fluorescent dye which shifts the wavelength spectrum of the light absorbed by the body to higher wavelengths. These bodies are not able to cast a diffuse light.

The lighting arrangements claimed in German utility model G 91 03 495.7 do have a high uniformity of luminance , but have a low transmission of the synthetic resin sheet materials which, according to the invention, must have high light reflection. This is linked to a decrease in the light output.

The problem of providing illuminated bodies which assure a uniform luminance on the wall surfaces of illuminated bodies with the least possible consumption of energy is solved by the illuminated bodies of the present invention.

The invention provides an illuminated body comprising synthetic resin sheets containing white pigment and fluorescent dye, the body having a plane of minimum cross section therein and an interior light source located in the plane of minimum cross section. The surface to volume ratio of the body is less than 6 : X where X is the value of the minimum cross section.

For the construction of illuminated bodies, sheets of transparent synthetic resin, stable against weathering, preferably of polymethyl methacrylate, or transparent carriers, preferably of glass such as silicate glass coated with transparent synthetic resin, are used.

As additives, the transparent synthetic resin contains 0.01 to 10 percent by weight, preferably 0.1 to 5 percent by weight, of white pigment; 0.001 to 1 percent by weight, preferably 0.005 to 0.1 percent by weight, of an organic fluorescent dye; as well as an optional 0.01 to 5 percent by weight, preferably 0.05 to 3 percent by weight, of a coloring pigment. However, any further dye which is optionally present should not absorb light of the wavelengths emitted by the excited fluorescent dye.

White pigments can be, for instance, titanium dioxide, zinc oxide, zinc sulfide, lead carbonate, basic lead sulfate, antimony oxide, barium sulfate, or mixtures of these. Preferably titanium dioxide in the rutile modification and barium sulfate are used (cf. Kirk-Othmer, Encyclopedia of Chemical Technology, 3rd edition, vol. 17, pages 801 to 814, John Wiley & Sons, New York, 1982).

As fluorescent dyestuffs, stilbene derivatives such as mono(azol-yl)-stilbene or bis(azol-yl)-stilbene, biphenyl derivatives such as 4,4'-bis(styryl)biphenyl, pyrazoline derivatives such as 1,3-diphenyl-2-pyrazoline, bis(benzazol-2-yl) derivatives, or coumarin derivatives such as 7-hydroxycoumarin are used (cf. Kirk-Othmer, loc.cit., vol. 4, pages 213 to 226, 1978). Further suitable fluorescent dyes are, for example, fluorescein, rhodamine, or perylene dyes which are excited under the influence of daylight and exhibit red, yellow, or green fluorescent light. Known commercial materials are "HOSTASOL"^{R} (Hoechst AG), "LISA"^{R}-dye (Bayer AG), and "LUMOGEN"^{R} (BASF AG).

The colored pigments which can be used in the present invention must satisfy a series of technical requirements: fastness to heat, resistance to oxidation, migration stability,

fastness to light, resistance to weathering, and dispersibility when being incorporated. For example, for coloring the polymethyl methacrylate preferably used, cadmium pigments comprising cadmium sulfide or mixtures of cadmium sulfide and cadmium selenide are used, the color scale of which runs from a greenish-tinged yellow to a dark bordeaux red. As a substitute for the cadmium pigments, organic colored pigments, such as "MACROLEX"^{R}-dye (Bayer AG), "SOLVAPERM"^{R}-dye (Hoechst AG), or "THERMOPLAST"^{R}-dye (BASF AG), for example, are added, which preferably contain from 0.01 to 3 percent by weight of one of the acids present in the polymer matrix (EP-OS 450 478) to improve fastness to light.

The illuminated bodies according to the invention have a high and very uniform luminance on their surfaces, i.e. on their walls, which is attributable to the combination of white pigments, fluorescent dye, and optional further coloring material.

Because of the excitation of fluorescence, there is a seemingly increased transmission of light by the illuminated bodies when concurrently uniformly lit, in comparison with illuminated bodies which exclusively have white pigments or the combination of white pigment and coloring material.

Even if the light source, which may be a filament bulb, a series of filament bulbs, or a fluorescent lamp, is so arranged in the illuminated body that the light directly emitted therefrom is non-uniformly distributed over the interior surface of the lighted body, the exterior surface of the illuminated body appears uniformly illuminated. The synthetic resin sheets which form the illuminated body and which contain white pigment, optional colorant, and fluorescent dye can be put almost

directly, i.e. in a separation of a few centimeters, from the light source without detection on the outside of the cast resin sheets of the light source because of areas having different brightness. Even obliquely incident light effects excitement of the fluorescence so that construction of the illuminated bodies having only a minimal depth is made possible. By "depth" is to be understood the ratio of surface area [in m^2) to volume [in m^3] (A : V) of the illuminated body in relation to the minimum cross section [in m] in the plane in which the light source is located. In ideally symmetric illuminated bodies, such as spheres or cubes, which are uniformly illuminated by a light source positioned to be centrally symmetric, this ratio A : V = 6 : X. For non-ideally symmetric illuminated bodies, such as rectangular solids, ellipsoids, or cones, such as are preferably used in illuminated advertisements, the ratio A : V < 6 : X. For these illuminated bodies, the exterior surfaces are not uniformly illuminated even with a centric arrangement and the illuminating source appears on the surface of the illuminated body as a bright spot, as already explained. The illuminated bodies of the invention do not have this disadvantage.

The illuminated bodies according to the present invention containing white pigment, fluorescent dye, and an optional further dye show an apparently increased transmission of light (measured as luminance according to DIN 5032, Part 1) and a uniform exterior illumination with minimal expenditure of energy for the light source. In this way, the synthetic resin sheets which form the illuminated body and which contain white pigment, fluorescent dye, and an optional further dye can be placed almost directly on the source or sources of illumination without indicating the location of the source or sources from the outside

of the resin sheets because of areas having different brightness. This means that the depth of the construction of the illuminated bodies, which normally is quite large for uniform illumination of the illuminated body and which thereby also has a higher energy requirement for the light source for comparable luminance on the surface of the illuminated body, can be considerably reduced, which also leads to a clear saving in material in construction of the illuminated bodies.

For a predetermined arrangement of white illuminating lamps, with polymethyl methacrylate sheets colored with fluorescent dye and white pigment according to the invention luminances are attained which are at least three times greater than are those possible using the same lamp arrangement with polymethyl methacrylate sheets colored in the usual way, i.e. with colored pigments. These observations or measurements are true both for transmitted light and reflected light. This means that the sheets prepared according to the present invention can give significantly more brightness under identical conditions of illumination than an ideal white and ideal light-diffusing material.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. An illuminated body comprising synthetic resin sheets containing white pigment and fluorescent dye, said body having a plane of minimum cross section therein and an interior light source located in the plane of minimum cross section, the surface to volume ratio of the body being less than 6 : X where X is the value of the minimum cross section.

2. An illuminated body as in Claim 1 wherein a further dye is present in addition to white pigment and fluorescent dye.

3. An illuminated body as in Claim 1 wherein the synthetic resin is polymethyl methacrylate.

4. An illuminated body as in Claim 1 wherein the synthetic resin containing white pigment and fluorescent dye is present as a layer on a transparent support.

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SUBSTITUTE

REMPLACEMENT

SECTION is not Present

Cette Section est Absente